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UNCLASSIFIED

ANALYSIS OF

KC-10 LOADING ALTERNATIVES

**Air
Force**



**Studies &
Analyses**

1 to Other

**Mr. Paul Tuck
(Study Director)**

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SLIDE 1 - TITLE:

THE ASSISTANT CHIEF OF STAFF, STUDIES AND ANALYSES, HQ USAF, WAS REQUESTED BY THE REQUIREMENTS REVIEW GROUP (RRG) TO COMPLETE A STUDY ON KC-10 LOADING ALTERNATIVES. ACCORDINGLY, THIS BRIEFING PRESENTS THE RESULTS OF AN ANALYSIS OF VARIOUS TYPES OF MATERIALS-HANDLING EQUIPMENT (MHE) THAT COULD BE USED FOR ON/OFF-LOADING KC-10 AIRCRAFT.

ADVANCES IN THE DEVELOPMENT OF TRANSPORT (AND TANKER) AIRCRAFT HAVE HISTORICALLY PACED DEVELOPMENT OF COMPLEMENTARY GROUND SYSTEMS.

SLIDE 2 - CONTENTS:

THIS SHOWS THE MAJOR AREAS THAT WILL BE COVERED DURING THE BRIEFING.

THE PURPOSE (SHOWN NEXT) WILL BE FOLLOWED BY SOME BACKGROUND MATERIAL ON MHE WHICH SHOULD ASSIST IN A BETTER UNDERSTANDING OF THE ANALYSIS TO FOLLOW LATER IN THE BRIEFING.

SLIDE 3 - PURPOSE:

THE PURPOSE OF THE STUDY WAS TO ANALYZE VARIOUS OPTIONS THAT MIGHT BE PURSUED TO ON/OFFLOAD KC-10s.

SLIDE 4 - MEASURES OF MERIT:

THIS SHOWS THE MEASURES OF MERIT THAT WERE CONSIDERED IN THE ANALYSIS. THE VARIOUS TYPES OF MHE WERE EXAMINED IN TERMS OF DAILY PRODUCTIVITY (SHORT TONS), AIRCRAFT LOADING TIMES (HOURS), AND COSTS.

WITH RESPECT TO INTEROPERABILITY, POTENTIAL MHE FOR SERVICING KC-10s WAS EVALUATED FOR POSSIBLE USE WITH THE B-747, C-141, AND C-130.

SAFETY IMPLICATIONS OF USING THE 15K FORKLIFT FOR KC-10 OPERATIONS WERE EXAMINED BECAUSE ASSERTIONS HAVE BEEN MADE THAT FORKLIFTS ARE SOMEWHAT UNSAFE FOR ON/OFFLOADING KC-10s.

SOME LOSS OF USABLE VOLUME (CAPACITY) AND WEIGHT-CARRYING CAPABILITY NORMALLY RESULTS FROM CARRYING AN ON-BOARD LOADER (OBL) ON AN AIRCRAFT.

USE OF ONE TYPE OF MHE IN PEACETIME, AND ANOTHER TYPE IN WARTIME, COULD RESULT IN THE SAC DUAL-DUTY LOADMASTER/BOOM OPERATOR NOT BEING COMPLETELY FAMILIAR WITH THE MHE UTILIZED IN WARTIME. TRAINING COULD MINIMIZE THIS IMPACT.

A FIRST STEP IN EXAMINING QUANTITATIVELY THE AMOUNT OF NEW MHE NEEDED FOR THE KC-10 SHOULD START WITH DETERMINING THE AMOUNT OF MHE THAT EXISTS NOW AND/OR IS PROGRAMMED.

SLIDE 5 - DC-10 ON-BOARD LOADER (OBL):

THIS SHOWS AN OBL MANUFACTURED FOR MARTINAIR BY WESTERN GEAR CORPORATION. THE KG-10 MILITARY TANKER/CARGO AIRCRAFT HAS ESSENTIALLY THE SAME MAIN DECK IN-PLANE CARGO SYSTEM AS THE DC-10 CIVIL CONVERTIBLE (USED BY MARTINAIR AND OTHERS). THE OBL IS NORMALLY USED WHEN NO OTHER LOADING EQUIPMENT IS AVAILABLE AT A PARTICULAR AIRFIELD. THE MARTINAIR OBL WEIGHS 6,040 LB. THE CARGO TO BE ON/OFFLOADED HAS TO PASS THROUGH THE UPPER FRAME, WHICH LIMITS CARGO DIMENSIONS TO ABOUT 125" x 108" PER ITEM. THE SYSTEM CAN BE USED WITH THE AUXILIARY POWER UNIT (APU) FROM THE AIRCRAFT.

ELEVATOR PLATFORM ASSEMBLY CHARACTERISTICS:

	<u>INCHES</u>
LENGTH	114
WIDTH	141
HEIGHT	20 (FROM GROUND LEVEL)
LIFTING RATE	26 FPM* (FOR LOADS UP TO 7,055 LB)
LOWERING RATE	15 FPM (ALL PALLETS)
LIFTING CAPACITY	13,228 LB

MARTINAIR WAS REQUESTED TO PROVIDE INFORMATION ON THE COST OF THEIR OBL. IT WAS INDICATED THAT THE OBL COST WAS INCLUDED WITH THE COST OF THEIR AIRCRAFT AND ACCORDINGLY COULD NOT BE PROVIDED. (WESTERN GEAR ALSO DECLINED TO PROVIDE THE OBL COST.)

* FPM MEANS FEET PER MINUTE.

SLIDE 6 - UPPER-FRAME-AND-LEG STOWAGE ON MAIN DECK:

THIS SHOWS THE PORTION OF THE MARTINAIR OBL THAT IS STOWED ON THE MAIN DECK ADJACENT TO THE SIDE-CARGO DOOR.

SLIDE 7 - PLATFORM STOWAGE IN LOWER LOBE:

THE MARTIN AIR OBL PLATFORM IS STOWED IN THE DC-10 LOWER LOBE. THE KC-10 HAS SEALED INTERNAL FUEL TANKS IN THE LOWER LOBES (AND NO CARGO DOORS). ACCORDINGLY, IT WOULD NOT BE POSSIBLE TO STORE ANY PORTION OF A KC-10 OBL IN THE LOWER LOBES.

THE MAXIMUM WEIGHT-CARRYING CAPACITY OF THE DC-10 FORWARD LOWER-LOBE RANGES FROM 21,000 TO 56,000 LB, DEPENDING UPON AIRCRAFT MODEL. IF THE OBL IS CARRIED IN THIS LOWER LOBE, IT WOULD NOT BE AVAILABLE FOR CARGO MOVEMENT.

SLIDE 8 - KC-135 ON BOARD LOADER (OBL):

THE KC-135 OBL CARGO-HANDLING SYSTEM INCLUDES THE OUTSIDE LOADER, WHICH HAULS CARGO THROUGH THE CARGO DOOR, AND THE INSIDE TRAVERSER WHICH HAULS CARGO FROM THE DOOR AREA TO ANY LOCATION INSIDE THE CARGO COMPARTMENT. THE SYSTEM IS ELECTRICALLY POWERED FROM THE AIRPLANE'S OWN SYSTEM, AND CAN LIFT UP TO 8,000 LB FROM THE GROUND TO THE CARGO DECK INSIDE THE AIRPLANE. AFTER HOISTING CARGO INTO THE AIRPLANE, THE OUTSIDE LOADER CAN BE DISMANTLED FOR STOWAGE IN A RACK ALONGSIDE THE CARGO. AT ITS DESTINATION, A CREW SETS UP THE LOADER AGAIN TO UNLOAD THE CARGO. THE TRAVERSER REMAINS IN POSITION DURING FLIGHT. NO LIFT TRUCKS OR GROUND-BASED HOISTS OF ANY KIND ARE NEEDED TO ON/OFFLOAD CARGO. A CREW OF FOUR MEN CAN INSTALL THE TRAVERSER AND HOIST UNIT IN 15 - 20 MINUTES. THE TRAVERSER RAILS AND HOIST UNIT CAN BE REMOVED FROM THE AIRPLANE IN ABOUT 15 MINUTES. HOWEVER, THE TRAVERSER RAILS CAN BE LEFT IN PLACE IN THE AIRPLANE. THE OUTSIDE LOADER OPERATES FROM TWO I-BEAM RAILS SUPPORTED BY A PORTABLE STRUCTURE INSTALLED THROUGH THE CARGO DOOR. UPRIGHT COLUMNS ALONG THE SIDES OF THE CARGO DOOR PROVIDE THE MAJOR SUPPORT FOR THE I-BEAM RAILS. FOUR MEN CAN INSTALL THE OUTSIDE LOADER IN 15 - 20 MINUTES. SINCE THE OUTSIDE LOADER RAILS RUN BELOW THE TRAVERSER RAILS, THE TRAVERSER MUST BE INSTALLED FIRST. THE OUTSIDE LOADER MUST BE TAKEN DOWN BEFORE FLIGHT.

SLIDE 9 - KC-135 ON-BOARD LOADER (CONTINUED):

THIS SHOWS THE LOCATION OF THE TRAVERSER HOIST AND TRAVERSER RAILS.

SLIDE 10 - EQUIPMENT ALTERNATIVES:

THE EQUIPMENT ALTERNATIVES ANALYZED FOR ON/OFFLOADING THE KC-10 ARE AS SHOWN.

SLIDE 11 - WESTERN GEAR KC-10 ON-BOARD LOADER:

THE SYSTEM CONSISTS OF A LARGE PLATFORM, HINGED TO THE AIRCRAFT STRUCTURE CLOSE TO THE CARGO DOOR AND AT ABOUT THE FLOOR LINE, WHICH ROTATES ABOUT THESE HINGES TO THE OPERATING POSITION. FROM THERE, A PLATFORM CARRYING THE CARGO PALLET IS LOWERED TO THE GROUND. THE PLATFORM STRUCTURE CONTAINS ROLLERS, ROLL-BACK STOPS, AND A DRIVE SYSTEM TO FACILITATE THE SAFE ON/OFFLOADING OF PALLETS. THE SYSTEM IS CONTROLLED BY A SMALL CONTROL PANEL ON THE AIRPLANE, OR BY USING A HAND-HELD PLUG-IN PENDANT.

THE PLATFORM IS A WELDED ALUMINUM STRUCTURE. INSIDE THE STRUCTURE ARE LOCATED THE WINCH FOR RAISING AND LOWERING THE PLATFORM, THE DRIVE WHEELS AND DRIVE MOTORS FOR ON/OFFLOADING, THE ROLLERS FOR SUPPORTING THE PALLET, AND THE ROLL-BACK STOPS FOR ENSURING SAFE PALLET RETENTION DURING TRANSFER. THE PLATFORM IS RAISED BY FOUR .25 DIAMETER STEEL CABLES ATTACHED TO THE HINGED FRAME AT THE TOP, AND WOUND ON A LARGE-DIAMETER WINCH DRUM SITUATED IN THE PLATFORM STRUCTURE. THE PALLET IS MOVED ON OR OFF THE PLATFORM USING TWO SETS OF DRIVE WHEELS. THESE ARE 10-INCH DIAMETER WHEELS SIMILAR TO THE TYPE EMPLOYED ON THE BOEING 747. CARGO PALLETS REST ON FIVE ROWS OF ALUMINUM ROLLERS SPACED AT 10-INCH INCREMENTS. THE PLATFORM IS EQUIPPED WITH FOUR ADJUSTABLE LEGS TO FACILITATE EASY LOADING AND UNLOADING OF PALLETS FROM THE GROUND. THE INTENT OF THESE DEVICES IS TO ENSURE A SAFE AND STABLE PLATFORM WHICH WILL MOST CONVENIENTLY INTERFACE WITH WHATEVER MHE, SUCH AS FORKLIFTS OR TRUCKS, IS AVAILABLE.

THE HINGED STRUCTURE IS A LARGE SECTION ALUMINUM FRAME WELDED FROM EXTRUSIONS. THE STRUCTURE PIVOTS ABOUT HINGE FITTINGS BOLTED TO THE AIRPLANE FLOOR. A SMALL HOIST AT THE FAR SIDE OF THE AIRPLANE IS USED TO RETRACT THE 750 POUNDS NEEDED TO LIFT AND STOW THE SYSTEM. THE OBL IS RETRACTED OR DEPLOYED IN LESS THAN 30 SECONDS.

OBL CHARACTERISTICS: SYSTEM WEIGHT, ABOUT 800 LB. 10,000 LIFT CAPACITY. LIFT/LOWER SPEED, 30 FPM.
WIDTH OF PLATFORM, 120". LENGTH OF PLATFORM, 92".

THIS OBL WAS NOT DESIGNED TO HANDLE THE KC-10 108" X 108"-SEAT PALLET.

SLIDE 12 - COCHRAN AIRPORT SYSTEMS (CAS) KC-10 ON-BOARD LOADER (OBL):

THE OBL IS COMPOSED OF SEVERAL MAJOR COMPONENTS, ALL OF WHICH ARE INTERLOCKED INTO A DEPLOYABLE PACKAGE AND STOWED OVERHEAD, INBOARD OF THE MAIN-CARGO DOORWAY. THIS LOCATION FOR STOWAGE PERMITS THE FULL CARGO FLOOR TO BE USED FOR PALLETTIZED CARGO. THE OBL IS CAPABLE OF BEING EXTENDED OUTWARD THROUGH THE MAIN-CARGO DOORWAY AND SUPPORTED FROM THE LOWER DOOR JAMB WITH ADDITIONAL STRUTS DURING THE HOISTING CYCLE. THE VERTICAL LIFTING PLATFORM IS CONVEYORIZED AND HAS POWERED LATERAL-DRIVE ROLLERS TO ASSIST IN MOVEMENT OF PALLETS ON/OFF AT AIRCRAFT-FLOOR OR GROUND LEVEL. THE SYSTEM IS CAPABLE OF LIFTING AN 8,400 LB GROSS WEIGHT PALLET AT 15 FEET PER MINUTE (FPM).

THE ELECTRICALLY POWERED LATERAL-TRANSFER ROLLERS ARE SIMILAR TO THE EXISTING KC-10 MAIN-DECK CARGO-SYSTEM ROLLERS, AND WILL TRANSFER PALLETS AT 30 FPM. THE LIFTING PLATFORM WILL ACCEPT 463L-SYSTEM 88" x 108" PALLETS ORIENTED IN THE LONGITUDINAL DIRECTION OF THE AIRCRAFT. THE PLATFORM IS ALSO EQUIPPED WITH TWO RETRACTABLE OUTRIGGERS TO LIFT THE NON-STANDARD SIZE 108" x 108" KC-10 SEAT PALLETS, WHICH HAVE A GROSS WEIGHT OF ABOUT 900 LB.

THE OBL HAS NINE MAJOR COMPONENTS. (1) UPPER FIXED TRACKS: TWO CONTINUOUS LATERALLY MOUNTED "I" SECTION TRACKS ARE ATTACHED WITH QUICK-DISCONNECT PINS TO THE MODIFIED OVERHEAD-SUPPORT STRUCTURE. THESE TRACKS PROVIDE THE VERTICAL SUPPORT FOR THE OBL IN THE STOWED POSITION AND THE TRACK FOR THE EXTENSION/RETRACTION OF THE OBL. THE TRACKS ARE CONNECTED BY LONGITUDINAL SUPPORT MEMBERS TO FORM A FOUR-SIDED BOX ASSEMBLY. (2) INTERMEDIATE CARRIAGE: THE INTERMEDIATE CARRIAGE HAS TWO CONTINUOUS LATERALLY-MOUNTED "I" SECTION TRACKS SUPPORTED FROM THE FIXED TRACKS. THE TWO TRACKS ARE COUPLED TOGETHER BY LONGITUDINAL MEMBERS TO FORM A U-SHAPED ASSEMBLY, AND PROVIDE VERTICAL SUPPORT FOR THE OUTER-CARRIAGE ASSEMBLY DURING THE EXTENSION/RETRACTION OF THE OBL. (3) OUTER CARRIAGE: THE OUTER CARRIAGE HAS TWO CONTINUOUS LATERALLY MOUNTED I-SECTION TRACKS SUPPORTED BY TRACK ROLLERS (CAM FOLLOWERS) FROM THE INTERMEDIATE-CARRIAGE ASSEMBLY. THE OUTER PORTION OF THE CARRIAGE FORMS A RECTANGULAR FRAME-ASSEMBLY WHICH HOUSES AND SUPPORTS THE PLATFORM-HOISTING MECHANISM. FOUR CABLES FROM THE HOISTING DRUMS ARE ROUTED TO THE CORNERS OF THE FRAME, THEN DOWNWARD TO THE LIFTING PLATFORM. FOUR MECHANICAL LATCHES WILL ENABLE THE OUTER CARRIAGE ASSEMBLY TO LATCH ONTO THE PLATFORM WHEN RAISED TO FULL-UP POSITION FOR STOWAGE IN THE OVERHEAD AREA OF THE AIRCRAFT. (4) DOOR-SILL ASSEMBLIES: THE AIRCRAFT LOWER-DOOR-JAMB AREA WILL BE PROTECTED BY A SERIES OF THREE DOOR-SILL-PROTECTOR ASSEMBLIES, TWO OF WHICH WILL BE SIMILAR TO THE EXISTING KC-10 CARGO-LOADING SYSTEM. THE THIRD WILL UTILIZE AN EXISTING ASSEMBLY OF THE KC-10 LOADING SYSTEM. (5) STRUTS (VERTICAL AND CANTED): FOUR STRUT ASSEMBLIES SHALL BE PROVIDED TO SUPPORT THE CANTILEVER OR EXTENDED-OUTER-CARRIAGE ASSEMBLY. THE CANTED OR OUTBOARD STRUTS SHALL BE SEMIPERMANENTLY ATTACHED TO THE OUTBOARD CORNER OF THE OUTER-CARRIAGE-ASSEMBLY FRAME. THE VERTICAL OR INBOARD STRUTS SHALL BE ATTACHABLE TO THE INBOARD CORNER OF THE OUTER-CARRIAGE FRAME. (6) POWER HOIST: AN ELECTRICAL-POWER-HOIST SYSTEM WILL BE INSTALLED WITHIN THE OUTER-CARRIAGE-FRAME ASSEMBLY. THE HOISTING-DRIVE UNIT WILL BE CONTROLLED FROM THE OBL-CONTROL PENDANT LOCATED ADJACENT TO THE CARGO-DOOR FORWARD JAMB. (7) PLATFORM: THE LIFTING PLATFORM IS 94" WIDE AND 132" LONG AND IS CAPABLE OF SUPPORTING, HOISTING, AND LOWERING AN 8,400-LB MAXIMUM LOAD ON AN 88" x 108" 463L-SYSTEM PALLET. THE PLATFORM HAS FOUR ROWS OF LATERAL-TRANSFER CONVEYORS WITH ROLLERS SPACED AT 10 INCHES ON-CENTER. THESE ROLLERS ARE IDENTICAL TO THE EXISTING KC-10 CARGO ROLLERS.

FOUR ELECTRICALLY POWERED DRIVE UNITS SIMILAR TO THE EXISTING KC-10 WILL BE INSTALLED TO ASSIST IN LATERAL MOVEMENT OF THE PALLETS ON/OFF THE PLATFORM AT BOTH GROUND LEVEL AND MAIN-CABIN-FLOOR HEIGHT. (8) ELECTRICAL SYSTEM: THE ELECTRICAL SYSTEM FOR OPERATION AND CONTROL OF THE OBL WILL BE INSTALLED IN THE OBL EQUIPMENT PANEL AND TWO CONTROL PANELS (FIXED AND PENDANT). LIMIT SWITCHES WILL CONTROL THE LATERAL MOVEMENT OF THE OBL DURING EXTENSION AND RETRACTION, AND HOISTING CABLE TRAVEL. (9) CARRIAGE DRIVE: AN ELECTRICALLY POWERED LATERAL-TRANSFER DRIVE UNIT WILL BE PROVIDED TO EXTEND/RETRACT THE INTERMEDIATE- AND OUTER-CARRIAGE ASSEMBLIES.

SLIDE 13 - PALLET-STACK HEIGHT:

THE THEORETICAL LOSS IN VOLUME (AS A RESULT OF USING THE OBL) WOULD BE 12 PERCENT.

HOWEVER, AS A PRACTICAL MATTER, THE ACTUAL LOSS WOULD PROBABLY BE LESS THAN 12 PERCENT SINCE REAL-WORLD EXPERIENCE HAS SHOWN THAT THE AVERAGE PALLET WEIGHT AND VOLUME ACHIEVED (BY MILITARY AIRLIFT COMMAND) IS 45 PERCENT AND 51 PERCENT, RESPECTIVELY. THIS EXPERIENCE DATA WERE RECORDED DURING THE VIETNAM CONFLICT, WHEN CARGO OPERATING LEVELS (BACKLOGS) WERE GENERALLY HIGH.

THE STRATEGIC AIR COMMAND (SAC) WOULD NORMALLY NOT HAVE SIMILAR CARGO BACKLOGS TO DRAW FROM FOR PEACE-TIME OPERATIONS, AND THEIR PALLET UTILIZATION IN TERMS OF WEIGHT AND VOLUME COULD WELL BE BELOW THE MILITARY AIRLIFT COMMAND's (MAC) WARTIME EXPERIENCE.

AS A RELATED MATTER, THERE IS A WEIGHT PALLET-LOAD LIMITATION ON 16 OF THE 27 KC-10 PALLET POSITIONS. MORE SPECIFICALLY; FIVE PALLET POSITIONS ARE LIMITED TO 5,400 LB, 11 PALLET POSITIONS ARE LIMITED TO 6,500 LB, AND 11 PALLET POSITIONS (NEAR THE WING) CAN ACCEPT THE FULL WEIGHT-CARRYING CAPACITY OF THE 463L-SYSTEM PALLET (10,000 LB).

THE PALLET-LOAD LIMITATION WOULD ALSO TEND TO REDUCE THE OVERALL WEIGHT AND VOLUME ACHIEVED IN THE KC-10 IN ACTUAL AIRLIFT OPERATIONS.

SLIDE 14 - FREQUENCY DISTRIBUTION OF THE VOLUME OF CARGO ON THE PALLET:

THIS FIGURE SHOWS THE DISTRIBUTION OF VOLUME REALIZED ON 463L-SYSTEM PALETS IN STRATEGIC RESUPPLY OPERATIONS.

THE ANALYSIS WAS BASED ON A SURVEY OF 5,372 PALETS BUILT UP AND AIRLIFTED FROM DOVER AFB TO SOUTHEAST ASIA FROM NOVEMBER 1967 TO JUNE 1968.

THE MAXIMUM VOLUME OF 528 CUBIC FEET WAS NEVER ATTAINED ON THE PALETS. A MEAN VOLUME OF 271 CUBIC FEET WAS ACHIEVED REPRESENTING 51 PERCENT OF THE TOTAL VOLUME AVAILABLE. THE VOLUME REALIZED ON 463L-SYSTEM PALETS CLOSELY APPROXIMATES A NORMAL DISTRIBUTION.

SLIDE 15 - FREQUENCY DISTRIBUTION OF THE WEIGHT OF CARGO ON THE PALLET:

THE DISTRIBUTION OF WEIGHTS LOADED ON 463L-SYSTEM PALETS IN STRATEGIC RESUPPLY OPERATIONS IS REFLECTED IN THIS FIGURE.

THE ANALYSIS WAS BASED ON A SURVEY OF 5,372 PALETS BUILT UP AND AIRLIFTED FROM DOVER AFB TO SOUTHEAST ASIA FROM NOVEMBER 1967 TO JUNE 1968.

THE MAXIMUM WEIGHT OF 10,000 POUNDS WAS NEVER REALIZED ON THE PALETS. THE MEAN WEIGHT ACHIEVED WAS 2.25 TONS WHICH REPRESENTS 45 PERCENT OF CAPACITY. THE WEIGHTS OBTAINED CLOSELY APPROXIMATE A NORMAL DISTRIBUTION.

SLIDE 16 - PENALTY FOR CARRYING NON-PRODUCTIVE TARE WEIGHT ABOARD AIRCRAFT

THE AMOUNT OF ADDITIONAL FUEL CONSUMED AS A RESULT OF CARRYING THE OBL WILL, OF COURSE, DEPEND ON THE WEIGHT OF THE OBL. FOR EXAMPLE, PAN AMERICAN ESTIMATED IN 1980 IT COST \$35.00 PER YEAR TO CARRY JUST ONE POUND OF TARE WEIGHT AT THEIR UTILIZATION RATES.

FLYING TIGERS ESTIMATED 41 POUNDS OF FUEL WOULD BE REQUIRED BY THE KC-10 TO LIFT 1,000 LB OF TARE WEIGHT FOR EACH HOUR OF FLIGHT.

INTERESTINGLY ENOUGH, ADDITIONAL FUEL WILL ALWAYS BE REQUIRED TO CARRY THE OBL ABOARD AN AIRCRAFT, WHEREAS ON SOME MISSIONS THERE WILL NOT BE A CONCOMITANT LOSS OF CARGO VOLUME--DEPENDING UPON THE PALLET-STACK HEIGHT OF THE PALLETIZED CARGO BEING CARRIED.

SLIDE 17 - COCHRAN AIRPORT SYSTEMS (CAS) ESTIMATED COSTS FOR KC-10 ON-BOARD LOADERS:

COSTS FOR VARYING NUMBERS OF OBLs ARE AS SHOWN IN PARTS I, II, AND III. THE UNIT PRICE VARIES WITH THE NUMBER OF LOADERS ORDERED, FROM A HIGH OF \$392,900 EACH FOR ONLY FIVE LOADERS, TO A LOW OF \$361,600 BASED ON A QUANTITY OF 30 LOADERS.

IRRESPECTIVE OF THE NUMBER OF LOADERS ORDERED, NONRECURRING COSTS AMOUNT TO \$841,720 FOR ITEMS LIKE: ENGINEERING DESIGN AND DEVELOPMENT; TOOLING; MAINTENANCE MANUAL WITH ILLUSTRATED PARTS CATALOG; AND CONSTRUCTION OF A MOCKUP AND QUALIFICATION ACCEPTANCE TEST.

THE FIRST ARTICLE WOULD COST ABOUT \$1.2 MILLION DOLLARS (INCLUDING THE NONRECURRING, ALONG WITH THE UNIT PRICE). IN THE EXAMPLE SHOWN OF A QUANTITY OF 30 LOADERS, IF ONE DIVIDES THE \$841,720 NONRECURRING COSTS BY 30 (\$28,057) AND ADDS THIS AMOUNT TO \$361,600, THE COST FOR EACH LOADER IS ABOUT \$390,000.

DOUGLAS AIRCRAFT HAS ELECTED TO FURNISH THE AIRCRAFT PARTS SHOWN IN PART III. COCHRAN AIRPORT SYSTEMS ESTIMATES THESE PARTS WILL COST ABOUT \$40,000 ADDITIONAL.

IT IS ASSUMED THAT THIS ADDITIONAL COST WOULD BE PASSED ON TO THE AIR FORCE, ALONG WITH AIRCRAFT MODIFICATION COSTS.

SLIDE 18 - KC-10 AIRCRAFT MODIFICATIONS:

THIS SHOWS THE AIRCRAFT MODIFICATIONS NEEDED TO MAKE THE KC-10 AIRCRAFT SUITABLE TO ACCEPT AND TRANSPORT THE KC-10 OBL.

DOUGLAS AIRCRAFT AND ASD (AERONAUTICAL SYSTEMS DIVISION, AIR FORCE SYSTEMS COMMAND, AFSC) WERE REQUESTED TO PROVIDE KC-10 AIRCRAFT MODIFICATION COSTS. SPECIFIC AIRCRAFT MODIFICATION COSTS WERE NOT PROVIDED. HOWEVER, SOME ROUGH ORDER OF MAGNITUDE (ROM) COST ESTIMATES FOR PRODUCTION INCORPORATION OF A DC-10 OBL IN THE 31st THRU THE 60th AIRCRAFT WERE PROVIDED BY ASD, AS FOLLOWS:

- a. NONRECURRING - \$7.64 MILLION
- b. RECURRING (A/C 31-60) - \$385,000 PER AIRCRAFT

THE ROM TO RETROFIT THE FIRST 30 AIRCRAFT IS:

- a. NONRECURRING - \$500,000
- b. RECURRING FOR AIRCRAFT PROVISIONS ONLY - \$100,000 PER AIRCRAFT

WITH RESPECT TO RETROFITABILITY, IF THE EARLY KC-10s ARE NOT MODIFIED AND THE LATE ONES ARE--COSTS WILL VARY.

SOURCE: AERONAUTICAL SYSTEMS DIVISION (ASD), AIR FORCE SYSTEMS COMMAND (AFSC).

SLIDE 19 - INTERIOR OF KC-10:

THIS SHOWS THE LOCATION WITHIN THE KC-10 WHERE THE OBL WOULD BE INSTALLED, WHETHER ANCHORED TO THE CEILING, HINGED IN THE DOORWAY, OR POSITIONED ON THE AIRCRAFT FLOOR.

IRRESPECTIVE OF THE TYPE OF OBL USED, SOME AIRCRAFT MODIFICATIONS (LIKE HARD POINTS AND POWER PLUGS) ARE ROUTINELY REQUIRED.

SLIDE 20 - COCHRAN AIRPORT SYSTEMS (CAS) AUSTERE ELEVATOR LOADER:

FOR THE PURPOSE OF THIS BRIEFING, AN AUSTERE ELEVATOR LOADER MAY BE DEFINED AS AN ELEVATOR THAT CAN ONLY HANDLE ONE OR TWO PALLETS AT A TIME.

THE ONE-PALLET ELEVATOR WOULD HAVE SEVERAL SERIOUS DEFICIENCIES, SUCH AS: ONLY 15,000-LB LIFT, NO POWERED WHEELS, LACK OF LADDER AND CONTROL PANEL, HAND-CRANKED STABILIZATION JACKS, A PINTO ENGINE, AND SOME COMPROMISE IN SAFETY.

SLIDE 21 - COCHRAN AIRPORT SYSTEMS (CAS) ELEVATOR LOADER, MODEL 316A:

THE TWO-PALLET AUSTERE ELEVATOR LOADER IS CONSIDERABLY IMPROVED OVER THE ONE-PALLET ELEVATOR. HOWEVER, IT TOO HAS SERIOUS SHORTCOMINGS, PARTICULARLY FOR MILITARY-AIRLIFT OPERATIONS.

FOR EXAMPLE, THE 25,000-LB LIFT CAPABILITY IS NOT SUFFICIENT FOR SOME UNIT EQUIPMENT LIKE THE HEAVIER TRUCKS BELONGING TO THE COMBAT FORCES. LIKEWISE, THE PLATFORM IS TOO SHORT FOR SOME ITEMS THAT CAN BE TRANSPORTED ON WIDE-BODIED AIRCRAFT.

THE AIR FORCE HAS 13 OF THESE UNITS.

SLIDE 22 - COCHRAN AIRPORT SYSTEMS (CAS) ELEVATOR LOADER, MODEL 316E:

THE AIR FORCE HAS 29 OF THESE UNITS. THIS THREE-PALLET, 40,000-LB LIFT ELEVATOR CAN GENERALLY HANDLE THE LARGEST AND HEAVIEST ITEMS THAT ARE AIR-TRANSPORTABLE IN KC-10s/B-747s.

39 ADDITIONAL SIMILAR UNITS ARE NOW UNDER CONTRACT WITH WILSON MACHINE COMPANY, HUTCHINSON, KANSAS, TO BE DELIVERED IN 1983. AN OPTION EXISTS TO INCREASE THIS NUMBER (UP TO 25 ADDITIONAL).

SLIDE 23 - WIDE-BODIED AIRCRAFT BEING LOADED WITH 15K FORKLIFT:

TESTS HAVE BEEN CONDUCTED USING THE 15K FORKLIFT TO ON/OFFLOAD DC-10 AND B-747 AIRCRAFT.

THIS SHOWS ACTUAL LOADING OPERATIONS DURING THE TEST.

THE TEST PROVED CONCLUSIVELY THAT WITH PROPERLY SKILLED PERSONNEL 15K FORKLIFTS CAN BE USED SAFELY TO ON/OFFLOAD SINGLE PALLETS.

DURING THE 1973 ISRAELI-EGYPTIAN OCTOBER WAR, THE 15K FORKLIFT WAS USED TO LOAD EL AL B-747 AIRCRAFT. LOADING OF THE UPPER DECK WAS DONE THROUGH THE REAR DOOR. CARGO WAS THEN MANHANDLED THROUGH THE DOOR AND ONTO WAREHOUSE-TYPE ROLLERS. FOUR-FEET-BY-EIGHT-FEET PIECES OF 3/4" PLYWOOD WERE USED AS SHORING.

IN THE DOUGLAS AIRCRAFT COMPANY MATERIALS HANDLING EQUIPMENT STUDY (KC-10 PROGRAM) COMPLETED IN MAY 1978 UNDER CONTRACT FOR ASD, THE 20K FORKLIFT WAS RECOMMENDED AS AN EXCELLENT SECONDARY PIECE OF EQUIPMENT FOR KC-10 MAIN-DECK ON/OFFLOADING.

DOUGLAS AIRCRAFT ALSO RECOMMENDS THE USE OF A FORKLIFT TO FEED PALLETS TO AND FROM THE OBL.

THE LIFTING PLATFORM WILL ALSO CONTAIN STEEL TROUGHS TO ACCOMMODATE FORKLIFT TINE ENTRY.

SLIDE 24 - FORKLIFT PALLET PLATFORM SIDE DELIVERY:

THIS SHOWS ANOTHER TYPE OF SLAVE PALLET THAT COULD BE USED IN CONJUNCTION WITH THE 15K FORKLIFT.

THIS DIFFERS FROM THE PREVIOUS EXAMPLE BECAUSE THE 15K FORKLIFT WOULD BE POSITIONED AT THE AIRCRAFT WITH THE FORKLIFT TIRES POINTING TOWARD THE FRONT (NOSE) OF THE AIRCRAFT. THE FORKLIFT WOULD NOT MOVE FROM ITS LOCATION DURING THE ENTIRE LOADING PROCESS, AND WOULD MERELY BE USED AS AN ELEVATOR TO RAISE/LOWER PALLETS. THE SLAVE PALLET COULD BE DESIGNED TO HAVE A HYDRAULIC OPERATED PUSH BAR OR HYDRAULIC POWER DRIVEN ROLLERS THAT WOULD MOVE THE PALLET ON OR OFF THE SLAVE PALLET THRU HYDRAULIC SOURCE SUPPLIED FROM THE FORKLIFT. (POWER COULD ALSO BE PROVIDED FROM THE KC-10 AIRCRAFT.)

THE 40K TRANSPORTER LOADER COULD BE USED TO FEED PALLETS TO/FROM THE FORKLIFT. EXTENDED TO ITS MAXIMUM ELEVATION, THE FORKLIFT, ACTING MERELY AS AN ELEVATOR, WOULD THEN ONLY BE REQUIRED TO RAISE OR LOWER TO OR FROM THE AIRCRAFT DOOR-SILL HEIGHT TO THE 40K.

THIS METHOD ACTUALLY ENHANCES THE WEIGHT-LIFTING CAPABILITY OF THE FORKLIFT. MORE SPECIFICALLY, SINCE THE LOADED PALLET IS PERPENDICULAR TO THE FORKLIFT, A LOWER-RATED FORKLIFT MAY BE USED FOR THIS METHOD THAN FOR END DELIVERY. THE SLAVE PALLET USED FOR SIDE DELIVERY HAS THE TINNEWAYS LOCATED ON THE LONG SIDE OF THE UNIT.

SLIDE 25 - TECHNICAL ORDER SYSTEM, PUBLICATION CHANGE REQUEST (PCR):

THE KC-10 LOADING MANUAL WAS CHANGED IN NOVEMBER 1981 TO REQUIRE PRIOR APPROVAL FROM HQ SAC TO USE A FORKLIFT.

THE INFORMATION SHOWN WAS EXTRACTED FROM A PUBLICATION-CHANGE REQUEST.

AS SHOWN EARLIER, 15K FORKLIFTS HAVE BEEN SAFELY USED TO LOAD WIDE-BODIED AIRCRAFT. WITH PROPERLY SKILLED/TRAINED PERSONNEL THIS EXPERIENCE COULD REASONABLY BE EXPECTED TO APPLY TO THE KC-10.

SLIDE 26 - AVAILABLE MATERIALS-HANDLING EQUIPMENT (MHE) TO LOAD/OFFLOAD WIDE-BODY AIRCRAFT:

AN EXTRACT FROM THE MAC FINAL TEST REPORT REFERRED TO EARLIER, CONCERNING UTILIZATION OF 15K FORKLIFTS FOR LOADING WIDE-BODIES, IS SELF-EXPLANATORY.

AS A RELATED MATTER, THE OTHER LOADER OPTIONS (ELEVATOR LOADER, 25K WITH ADAPTER, KC-10 OBL) WOULD NOT HAVE THE CAPABILITY TO ON/OFFLOAD LOWER LOBES OF WIDE-BODIES.

SLIDE 27 - 25K TRANSPORTER LOADER WITH ADAPTER:

THE POTENTIAL USE OF THE 25K TRANSPORTER LOADER WITH ADAPTER WAS TESTED BY THE USAF AIRLIFT CENTER, MILITARY AIRLIFT COMMAND, POPE AFB, NC.

THE FINAL TEST REPORT INDICATED THAT THE 25K TRANSPORTER LOADER WITH ADAPTER CANNOT BE ADEQUATELY STABILIZED TO ALLOW SAFE TRANSFER OF CARGO AT WIDE-BODY AIRCRAFT CARGO DECK HEIGHTS.

THE 25K WITH ADAPTER WOULD BE TOO HIGH TO INTERFACE WITH TRUCK-BED HEIGHT AIRCRAFT LIKE THE C-130/C-141. THE USE OF A RELATIVELY EXPENSIVE TRANSPORTER LOADER WITH ADAPTER MERELY AS AN ELEVATOR IS ALSO SOMEWHAT QUESTIONABLE.

THE LIFTING CAPABILITY OF THE 25K TRANSPORTER LOADER WOULD BE DEGRADED BY AN AMOUNT EQUAL TO THE WEIGHT OF THE ADAPTER.

USE OF THE 25K WITH ADAPTER FOR B-747 ON/OFFLOADING WOULD ALSO POSE SOME SERIOUS CONSTRAINTS.

SLIDE 28 - CARGO LOADER ACCESS ROUTE TO B-747 SIDE DOOR:

DUE TO THE SWEET OF THE B-747 WING, IT WOULD BE NECESSARY TO DRIVE AND MANUEVER (THE 25K WITH ADAPTER) UNDER THE WING WHILE ALIGNING THE ADAPTED 25K WITH THE SIDE CARGO DOOR.

DURING THE ALIGNING PROCEDURE, THE HAND RAILS COME VERY CLOSE TO THE AIRCRAFT WING TIP AND WING-MOUNTED PYLON.

ACCORDINGLY, THE 25K WITH ADAPTER WOULD ALSO HAVE POOR INTEROPERABILITY CHARACTERISTICS.

SLIDE 29 - CAPABILITY OF MAIN-DECK LOADING EQUIPMENT FOR WIDE-BODIED AIRCRAFT:

THIS MATRIX SHOWS THE EFFECTIVENESS (OR LACK OF) OF THE VARIOUS TYPES OF MATERIALS-HANDLING EQUIPMENT WHEN RELATED TO THE LARGER AND HEAVIER ITEMS THAT ARE AIR-TRANSPORTABLE BY KC-10/B-747 AIRCRAFT.

AN X PLACED OPPOSITE THE MHE IN ONE OR MORE OF THE COLUMNS INDICATES THE MHE CAN HANDLE THE PARTICULAR ITEM(S) RANGING FROM A SINGLE PALLET TO A 5-TON TRUCK.

AS SHOWN, THE ELEVATOR LOADER IS SUPERIOR TO ANY OF THE OTHER OPTIONS FROM A TOTAL FLEXIBILITY STANDPOINT TO HANDLE A WIDE VARIETY OF BULK/OVERSIZE CARGO.

THE 15K FORKLIFT AND OBL ARE LIMITED TO SINGLE PALLETS.

THE LIFTING/LOWERING SPEED OF THE 25K WITH ADAPTER IS VERY SLOW; THE 15K FORKLIFT IS VERY FAST.

TWO OR MORE MARRIED 463L - SYSTEM PALLETS ARE USED TO AIRLIFT CARGO THAT IS TOO HEAVY OR TOO LARGE FOR A SINGLE PALLET.

AS EXAMPLES, THE WILSON ELEVATOR LOADERS FOR WIDE-BODIES REQUIRE THREE MARRIED PALLETS PLUS ONE ADDITIONAL SINGLE PALLET, OR A TOTAL OF 4 PALLETS. THIS MARRIED - PALLET REQUIREMENT WILL APPLY 100% OF THE TIME (PEACETIME AND WARTIME) WHEN ELEVATORS ARE MOVED BY AIRLIFT.

AIRCRAFT ENGINES ARE ALSO ROUTINELY MOVED ON MARRIED PALLETS, DURING BOTH PEACETIME AND WARTIME. ACCORDINGLY, HQ SAC INCLUDED THIS MARRIED - PALLET CAPABILITY AS A DESIRABLE FEATURE FOR THE KC-10 OBL IN SAC SON 03-81.

MARRIED PALLETS ARE NORMALLY USED FOR MOVEMENT OF CONTAINERS ON MILITARY AIRCRAFT--BOTH PEACETIME AND WARTIME.

SLIDE 30 - TRAINING CONSIDERATIONS:

IN THE REQUEST TO AF/SA FOR THIS STUDY IT WAS INDICATED THAT THE STUDY EMPHASIS SHOULD BE ON PEACETIME SINGLE-PALLET OPERATIONS.

CONCEPTUALLY, THERE IS SOME QUESTION ABOUT THE TRAINING IMPLICATIONS OF HAVING ONE SET OF MHE FOR PEACE-TIME AND ANOTHER SET FOR WARTIME.

FOR EXAMPLE, THE KC-10 DUAL-DUTY LOADMASTER/BOOM OPERATOR SHOULD BE TRAINED IN LOADING THE LARGE AND HEAVY ITEMS BELONGING TO THE COMBAT FORCES AND THE WARTIME MHE, AS WELL AS PEACETIME SINGLE-PALLET OPERATIONS.

IN OTHER WORDS, SOME TYPE OF FORMAL LOADMASTER TRAINING SUPPLEMENTED WITH ACTUAL EXPERIENCE IN BOTH PEACETIME AND CONTINGENCY-TYPE AIRLIFT OPERATIONS WITH THE KC-10 WOULD ENHANCE READINESS.

SLIDE 31 - COMPARISON OF PRODUCTIVITY, TIME, AND COST OF MATERIALS-HANDLING EQUIPMENT WHEN LOADING KC-10 AIRCRAFT:

THIS SHOWS THE TIME REQUIRED TO LOAD A KC-10 WITH 27 LOADED PALLETS, DAILY PRODUCTIVITY, AND COSTS OF THE VARIOUS TYPES OF MHE AS INDICATED. THE COMPUTATIONS ARE BASED ON AN OPERATION WHERE THE ALREADY BUILT-UP PALLETS ARE ASSEMBLED IN A STAGING AREA 1 1/4 MILE FROM THE AIRCRAFT. A 40K TRANSPORTER LOADER IS USED TO FEED LOADED PALLETS FROM THE STAGING AREA TO THE VARIOUS TYPES OF MHE STATIONED AT THE AIRCRAFT DURING THE ENTIRE LOADING PHASE. THE DAILY TONNAGE PRODUCTIVITY IS BASED ON A 24-HOUR DAY. THE TIME IS CALCULATED FROM THE TIME THE MHE IS POSITIONED AT THE AIRCRAFT AND THE FIRST PALLET IS LOADED ON THE AIRCRAFT. THE TOTAL TIME CONSISTS OF THREE PARTS: (1) THE TIME TO POSITION THE LOADERS AND MOVE THE PALLETS INTO THE AIRCRAFT; (11) THE TIME TO RECYCLE THE 40K TRANSPORTER LOADER BETWEEN THE CARGO STAGING AREA AND THE AIRCRAFT; AND (111) THE LIFTING/LOWERING TIME.

ONE MINUTE PER PALLET WAS USED TO MOVE PALLETS WITH A POWERED FLOOR: AND TWO MINUTES PER PALLET, WITHOUT A POWERED FLOOR. THE LIFTING/LOWERING TIME VARIES GREATLY AMONG THE DIFFERENT TYPES OF MHE. THE COST IS BASED ON NEW LOADER COSTS FOR ONE PIECE OF EQUIPMENT IN FY-83 DOLLARS. THE 25K ADAPTER COST IS \$40,000 AND THE NEW 25K IS \$125,000, FOR A TOTAL OF \$165,000.

A CLOSE SIMILARITY EXISTS IN THE AIRCRAFT LOADING TIME BETWEEN THE ELEVATOR LOADER AND 15K FORKLIFT. THE 15K IS LOWEST IN COST AND OVERALL LOADING TIME, AND HIGHEST IN DAILY PRODUCTIVITY BECAUSE OF ITS HIGH LIFTING/LOWERING SPEED. THE 25K TRANSPORTER LOADER WITH ADAPTER HAS THE LONGEST AIRCRAFT LOADING TIME, DUE TO ITS SLOWEST LIFTING/LOWERING TIME AMONG ALL OF THE MHE EXAMINED, AND THE LACK OF A POWERED FLOOR.

THE OBL WOULD COST ABOUT \$390,000 WHEN THE \$841,720 R&D COST IS AMORTIZED OVER 30 UNITS. THE FIRST ARTICLE WOULD COST ABOUT \$1.2 MILLION DOLLARS (INCLUDING THE NONRECURRING AND UNIT COSTS) AS INDICATED BY THE ARROW AT THE TOP OF THE COST SCALE.

SLIDE 32 - AVAILABILITY OF MATERIALS-HANDLING EQUIPMENT FOR KC-10 CARGO OPERATIONS:

SAC WAS REQUESTED TO PROVIDE AN EXPRESSION OF PEACETIME REQUIREMENTS FOR THE KC-10 IN TERMS OF TONNAGE/PALLETS/TROOPS, ON/OFFLOAD STATIONS AND FREQUENCY OF SERVICE BETWEEN LOCATIONS.

SAC USED KC-135 EXPERIENCE (6-MONTH PERIOD) TO FORECAST KC-10 OPERATIONS. DURING THE DATA COLLECTION PERIOD, 30 BASES ORIGINATED ABOUT SEVEN KC-135 MISSIONS A MONTH WITH CARGO AND/OR TROOPS DESTINED TO ONE OR MORE OF 112 LOCATIONS WORLDWIDE. ARRIVAL LOCATIONS ON AN AVERAGE HANDLED APPROXIMATELY 1.8 KC-135 MISSIONS WITH CARGO AND/OR TROOPS PER MONTH. THE AVERAGE KC-135 MISSION FOR THE PERIOD CARRIED ABOUT 17 TROOPS AND 5.5 TONS OF BAGGAGE/MISSION SUPPORT EQUIPMENT/SUPPLIES.

THE SAC ROUTE PATTERN WAS EXAMINED AS TO THE AVAILABILITY OF MATERIALS-HANDLING EQUIPMENT FOR KC-10 ON/OFFLOADING.

AN ARROW PLACED AFTER THE NAME OF EACH LOCATION INDICATES THAT WIDE-BODIED MHE EXISTS NOW OR IS PROGRAMMED.

A BULLET PLACED BEFORE THE NAME OF THE LOCATION INDICATES THAT 15K FORKLIFT CAPABILITY EXISTS NOW.

THE ABSENCE OF AN ARROW AND BULLET MEANS EQUIPMENT IS NOT AVAILABLE TO ON/OFFLOAD THE KC-10.

SLIDE 32A - AVAILABILITY OF MATERIALS-HANDLING EQUIPMENT FOR KC-10 CARGO OPERATIONS (CONTINUED):

THE EUROPEAN AND PACIFIC LOCATIONS USE THE SAME LEGEND AS PREVIOUSLY EXPLAINED.

SLIDE 32B - AVAILABILITY OF MATERIALS-HANDLING EQUIPMENT FOR KC-10 OPERATIONS (CONTINUED):

THE NORTH COUNTRY (AND OTHER) LOCATIONS REFLECTED ON THIS MAP USE THE SAME LEGEND AS PREVIOUSLY EXPLAINED.

SLIDE 32C - KC-10 FORECASTED TO OPERATE AT 113 LOCATIONS:

THIS SHOWS THE NUMBER AND PERCENTAGE OF LOCATIONS (WHERE SAC EXPECTS TO OPERATE THE KC-10s) THAT HAVE MHE (IN PLACE OR PROGRAMMED) FOR MAIN-DECK KC-10 OPERATIONS.

IN BRIEF, 75% OF THE 113 PLANNED LOCATIONS HAVE EQUIPMENT FOR ON/OFFLOADING KC-10s.

SLIDE 33 - UTILIZATION OF CARGO LOADERS FOR WIDE-BODIED AIRCRAFT:

A 6-MONTH SURVEY WAS CONDUCTED TO DETERMINE THE USAGE (OR LACK OF) OF ELEVATOR LOADERS PRESENTLY OWNED BY THE AIR FORCE.

IN BRIEF, ONLY 5 BASES OUT OF 26 USED THE ELEVATOR LOADERS WITH ANY SIGNIFICANT DEGREE OF REGULARITY.

THE LOADER UTILIZATION BY BASE SHOWN DOES NOT INCLUDE CASES WHERE THE LOADERS ARE TEMPORARILY MOVED TO ANOTHER LOCATION FOR A SHORT PERIOD OF TIME, OTHER THAN WHERE REGULARLY ASSIGNED.

SLIDE 34 - MATERIALS-HANDLING EQUIPMENT LOCATIONS FOR WIDE-BODIED AIRCRAFT:

THIS MAP SHOWS WORLD-WIDE LOCATIONS WHERE MATERIALS-HANDLING EQUIPMENT EXISTS (OR IS PROGRAMMED) FOR ON/OFFLOADING WIDE-BODIES.

IT INCLUDES: (1) MHE OWNED BY THE AIRLINE INDUSTRY AND FIXED-BASE OPERATORS LIKE AIRPORT-SERVICING COMPANIES AND AIRPORT AUTHORITIES AND (11) THE US AIR FORCE.

AS CAN BE SEEN, THERE IS ACTUALLY A PROLIFERATION OF MHE FOR WIDE-BODIES (AS OPPOSED TO A SHORTAGE).

SLIDE 34A - MATERIALS-HANDLING EQUIPMENT LOCATIONS FOR WIDE-BODIED AIRCRAFT (CONTINUED):

THIS MAP COMPLETES THE OVERALL WORLDWIDE STORY WITH RESPECT TO THE AVAILABILITY OF MHE FOR WIDE-BODIES.

SLIDE 35 - KC-10 LOADING ALTERNATIVES:

COMMENTS ON THE LOADING ALTERNATIVES WERE ALSO REQUESTED FROM AIRCRAFT MANUFACTURERS OF WIDE-BODIED AIRCRAFT, AS WELL AS THE AIRLINE INDUSTRY.

BOEING IS PARTICULARLY KNOWLEDGEABLE ON CARGO LOADING OPERATIONS FOR WIDE-BODIES SINCE THEY HAVE DELIVERED ABOUT 560 B-747s (INCLUDING ALL CONFIGURATIONS--FREIGHTERS, CONVERTIBLES, COMBIS, AND PURE PASSENGER AIRCRAFT).

FLYING TIGER IS THE LARGEST CIVIL CARGO CARRIER IN THE WORLD.

AS INDICATED, MARTINAIR ALSO USES FORKLIFTS FOR ON/OFFLOADING THEIR DC-10 CONVERTIBLES WHEN OTHER HIGH-REACH MHE IS NOT AVAILABLE.

SLIDE 36 - OBSERVATIONS:

THE ADVANTAGES AND DISADVANTAGES OF THE KC-10 OBL AND ELEVATOR LOADER ARE AS INDICATED.

THE ELEVATOR LOADER IS RELATIVELY INEXPENSIVE, CAN HANDLE PALLETS, CONTAINERS, AND UNIT EQUIPMENT (DURING PEACETIME OR WAR) AND HAS GOOD AIR-TRANSPORTABILITY CHARACTERISTICS.

ALL B-747 CARGO OPERATORS OF THE WORLD (EXCEPT AMERICAN AND KOREAN AIRLINES) HAVE PURCHASED ELEVATOR LOADERS.

SLIDE 36A - OBSERVATIONS (CONTINUED):

ADVANTAGES/DISADVANTAGES FOR THE OTHER KC-10 LOADING ALTERNATIVES ARE ALSO SHOWN.

INDUSTRY CONTACTED DID NOT SHOW ANY INTEREST IN LEASING LOADERS FOR ON/OFFLOADING KC-10s.